

SRP

Interconnection Guidelines

For

Distributed Generators

December, 2000

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1. NOTICE OF DISCLAIMER AND USE OF REFERENCES

NOTICE OF DISCLAIMER: All information contained in this document is made available for the sole and limited purpose of providing general information regarding Customer-owned generation on the Salt River Project Agricultural Improvement and Power District (SRP) electric system. Nothing stated in this material should be construed as a promise, assurance, or warranty by SRP regarding the obligations of SRP with respect to Customer-owned generation on the SRP system. Any promises, assurances, warranties or obligations between SRP and Customer-owned generation connected to the SRP system shall be in writing and executed by all appropriate parties.

USE OF REFERENCES: There are numerous documents and standards that were used in developing these guidelines. Many of these documents are modified and updated over time; the equipment of an interconnected generator shall conform to the most recent versions of these documents. A partial list of documents used is included below:

- IEEE SCC 21 P1547, “Standard for Distributed Resources Interconnected with Electric Power Systems” (presently in draft form)
- IEEE 519-1992, “IEEE Recommended Practices and Requirements for Harmonic Control in Electrical Power Systems”
- IEEE 929-2000, “IEEE Recommended Practice for Utility Interface of Residential and Intermediate Photovoltaic (PV) Systems
- Arizona Corporation Commission Docket #E-00000-A-9-0431, “Arizona State Draft Interconnection Requirements For Distributed Generation”
- National Electrical Code (NEC)
- National Electric Safety Code (NESC)
- SRP Electric Service Specifications
- SRP Rules & Regulations (formerly, also called SRP Electric Service Guidelines)

2. SCOPE

This document specifies the SRP requirements for safe and effective interconnection of a Distributed Generator (DG) with a utility distribution system (connections at 25 kV and below). Refer to the note below for general comments regarding connections to the transmission system.

The required protective relaying and safety devices specified in this document are for protecting only SRP facilities and SRP customers from damage or disruptions caused by a failure, malfunction or improper operation of the DG facility. They are also necessary to ensure the safety of SRP workers and the public. The requirements specified herein do not include additional relaying, protective or safety devices as may be required by industry or government codes and standards, equipment manufacturer requirements and prudent engineering design and practice to fully protect the Customer's facility. Any other contractual agreements between SRP and the Customer take precedence over the general provisions of this document.

Customers and SRP personnel shall use this document when planning the installation of distributed generation. Note that these requirements may not cover all details in specific cases. Therefore, discuss project plans with SRP before designing the facility or purchasing and installing equipment.

NOTE: Installations that interconnect to, or back-feed onto, the transmission system (above 25 kV) will have additional utility requirements, including, but not limited to:

- Voltage and power factor control, including automatic voltage regulation requirements
- Reactive Power
- System Protection and other controls
- Abnormal frequency and voltage operation
- Data submission on demand from regulators

Such a transmission-connected generator will also need to comply with all applicable requirements of the Western Systems Coordinating Council, Desert STAR Independent System Operator, North American Electric Reliability Council and Regional Transmission Operator requirements as applicable. Facilities that will be connected directly to the transmission system will be reviewed by SRP on an individual basis.

3. DEFINITIONS

- 3.1 Clearance Point: The physical location on a section of a power line or equipment that is to be visibly disconnected from all known sources of power.
- 3.2 Customer: Anyone connected to the SRP electrical system that installs, owns or operates a Distributed Generator, co-generation or small power production facility. This includes any independent party or entity that invests in, owns or operates a DG or generation facility. (Note that “customer” without the first letter capitalized refer to all other SRP electric and water users.)
- 3.3 Distributed Generator (DG): A general term for all or part of the Customer’s distributed electrical generator(s) or inverter(s) together with all protective, safety, and associated equipment necessary to produce electric power at the Customer’s facility. The generator itself can be any type of electrical generator or static inverter producing alternating current that has the capability of Parallel Operation with the SRP distribution system. This also includes generators or inverters serving loads that can be served either by the generator or the SRP system using a transfer switch.
- 3.4 Electric Service Specifications (ESS): An SRP set of standards and specifications a customer must follow in order to connect to the SRP system. The ESS is not a complete set of rules, and more complex systems (including DGs) are subject to additional requirements.
- 3.5 Electric Supply/Purchase Agreement: An agreement signed between SRP and the Customer (generating facility) covering the terms and conditions under which electrical power is supplied to, or purchased from, SRP.
- 3.6 Electric Service Provider (ESP): A company supplying, marketing or brokering at retail any competitive services pursuant to a Certificate of Convenience and Necessity.
- 3.7 Generating Facility: See Distributed Generator
- 3.8 Hold Tag: The method used as an aid in protection of personnel working on or near energized equipment, whereby Reclosing of a line is disabled.
- 3.9 Integrated Distributed Resources (IDR): DGs with protective functions built into the unit’s control system for operating interconnected with the utility
- 3.10 Interconnection Agreement: An agreement, together with appendices, signed between SRP and the Customer (generating facility) covering the terms and conditions governing the interconnection and operation of the Generating Facility with SRP.
- 3.11 Interconnection Generation Design Review Agreement: An agreement signed between SRP and the Customer covering the terms for SRP to proceed with a detailed study of the impact of the Customer’s DG on SRP’s system.
- 3.12 Islanding: A condition occurring when a generator and a portion of the SRP system separates from the remainder of the SRP system and continues to operate in an energized state. At present,

SRP has no systems designed to intentionally Island. When the condition is unintentional, Islanding may pose a safety threat or cause equipment problems.

- 3.13 Metering Service: All functions related to measuring transfer of electric power and energy.
- 3.14 Parallel Operation: The operation of a DG that is electrically interconnected to a bus common with the SRP electrical system, either on a momentary or on a continuous basis.
- 3.15 Point of Common Coupling: See Point of Interconnection.
- 3.16 Point of Interconnection: The physical location where the SRP's service conductors are connected to the Customer's service conductors, at which point the power transfer occurs between the Customer's electrical system and the SRP distribution system, also referred to as the Point of Common Coupling.
- 3.17 Reclosing: The act of automatically re-energizing a line in an attempt to quickly restore power to Customers.
- 3.18 SRP: The Salt River Project Agricultural Improvement and Power District.
- 3.19 Transfer Switch: An automatic or non-automatic device for transferring one or more load conductor connections from one power source to another.
- 3.20 Utility Grade Relays: Relays specifically designed to protect and control electric power apparatus, tested in accordance with the following ANSI/IEEE standards:
 - (a) ANSI/IEEE C37.90-1989 (R1994), IEEE Standard for Relays and Relay Systems Associated with Electric Power Apparatus.
 - (b) ANSI/IEEE C37.9.01-1989 (R1994), IEEE Standard Surge Withstand (SWC) Tests for Protective Relays and Relay Systems.
 - (c) ANSI/IEEE C37.90.2-1995, IEEE Standard Withstand Capability of Relay Systems to Radiated Electromagnetic Interference from Transceivers.

4. DISTRIBUTED GENERATION TYPES

A Distributed Generator is any type of electrical generator or static inverter producing alternating current, that has the capability of Parallel Operation with the SRP distribution system, or is designed to operate separately from the SRP system and can feed a load that can also be fed by the SRP electrical system.

4.1 Separate System (Emergency or Standby Generation System)

A separate system is one in which there is no possibility or intent of electrically connecting or operating the Customer's DG in parallel with the SRP system. The Customer's equipment must transfer load between the two power systems in an open transition or non-parallel mode. If the Customer claims to have a separate system, SRP may require verification that the transfer scheme meets the non-parallel requirements.

Emergency or standby DGs used to supply part or all of the Customer's load during SRP power outages, are required by the National Electrical Code to have transfer equipment designed and installed to prevent the inadvertent interconnection of normal and emergency sources of supply in any operation of the transfer equipment.

As such, these DGs must be connected to the Customer's wiring through a double throw, break-before-make transfer switch specifically designed and installed for that purpose. The transfer switch must be of a fail-safe mechanical throw over design, which will under no circumstances allow the DG to electrically interconnect or parallel with the SRP system. The transfer switch must always disconnect the Customer's load from the SRP power system prior to connecting it to the DG. Conversely, the transfer switch must also disconnect the load from the DG prior to reconnecting it to the SRP system. These requirements apply to both actual emergency operations as well as to testing the DG. All transfer switches and transfer schemes must be inspected and approved by the governmental bodies that exercise legal jurisdiction over electrical installations.

Portable generators are not designed for connection to a building's permanent wiring system, and are not to be connected to any such wiring unless a permanent and approved transfer switch is used. Failure to use a transfer switch can result in back-feed into the SRP system – the generator voltage can back-feed through the SRP transformer and be stepped up to a very high voltage. This can pose a potentially fatal shock hazard to anyone working on the power lines or on SRP equipment.

4.2 Parallel System (Interconnected Generation Systems)

A parallel, or interconnected, DG is connected to a bus common with SRP's system, and a transfer of power between the two systems is a direct result. A consequence of such interconnected operation is that the Customer's DG becomes an integral part of the SRP system that must be considered in the electrical protection and operation of the SRP system.

Parallel generators encompass any type of Distributed Generator that can electrically parallel with, or potentially back-feed to the SRP system. Additionally, any generator system using a "closed transition" type transfer switch or a multi-breaker transfer scheme, or an electrical inverter that can

be configured or programmed to operate in a “utility interactive mode” constitutes a potential back-feed source to the SRP system, and is classified as an interconnected DG.

The technical requirements for interconnected DGs are detailed in Section 7. SRP will inspect and review the design of each DG on a case-by-case basis.

5. GENERAL INFORMATION AND REQUIREMENTS

The Customer will own and be responsible for designing, installing, operating and maintaining:

- (a) The generating facility in accordance with the requirements of all applicable electric codes, laws and governmental agencies having jurisdiction.
- (b) Any control and protective devices, in addition to protective relays and devices specified in this document, to protect its facilities from abnormal operating conditions such as, but not limited to, electric overloading, abnormal voltages, and fault currents.
- (c) Interconnection facilities on the Customer's premises as may be required to deliver power from the Customer's generating facility to the SRP system at the Point of Interconnection.

In the event that additional facilities are required to be installed on the SRP system to accommodate the Customer's DG, SRP will install such facilities, generally at the Customer's expense. SRP may also charge the Customer for any administrative costs, or the costs of studies required to interconnect the Customer's generation.

5.1 Insurance

Customers interconnecting a DG must comply with insurance requirements specified in the Interconnection Agreement between the Customer and SRP.

5.2 Interconnection Agreement

All interconnected Customers are required to sign, in addition to any other special agreements as may be applicable, an Interconnection Agreement with SRP.

5.3 Construction Agreement

In the event that SRP equipment (new equipment or modifications to existing equipment) is needed, Customers are required to sign a Construction Agreement with SRP.

5.4.1 Electric Supply/Purchase Agreement

Customers purchasing energy from SRP utilizing an interconnected DG system, will be required to have an agreement for backup, supplemental and maintenance power with an energy supplier.

5.4.2 Selling Power to Others

For a Customer who wishes to use SRP facilities to sell power to others, the Customer will be required to sign an agreement with SRP for wheeling power over SRP's transmission and distribution grid, as well as meet any other applicable Arizona Corporation Commission requirements.

5.5 Interconnections

Only authorized SRP employees may make and energize the service connection at the Point of Interconnection with SRP.

5.6 Easements and Rights of Way

Where an easement or right of way is required to accommodate the interconnection, the Customer shall provide, or obtain from others and provide, suitable easements or rights of way, in SRP's name, prior to energizing those facilities.

5.7 Meter Installations

Reactive metering is required for all DG installations greater than 50 kW. Smaller units will be reviewed on a case-by-case basis. If the Customer intends to sell energy back to SRP or others, then additional metering equipment is required. Contact SRP for design requirements and installation details.

6. DESIGN CONSIDERATIONS AND DEFINITION OF CLASSES

The size and characteristics of the parallel generator along with the nature and operational characteristics of SRP's system influence protection requirements. Therefore, similar units connected to different lines could have different protection requirements based on varying load conditions, as well as on SRP feeder and transformer characteristics.

Reclosing by SRP is typically instantaneous, that is, after the first opening of a substation feeder breaker, the line is re-energized in about a tenth of a second. There is no intentional time delay. Because of this, the Customer is responsible for designing the DG system to automatically separate from the SRP system upon loss of SRP voltage and prior to reclosing of the SRP feeder.

6.1 Synchronous Units

A synchronous generator is an alternating-current machine in which the rotational speed of normal operation is constant, and when interconnected, is in synchronism with the frequency and in step with the voltage of the electric utility system. Synchronous generators are generally capable of supplying sustained current for faults on the SRP system.

6.2 Induction Units

Induction generators are basically induction motors that are driven above synchronous speed to produce electric power. These units do not have a separate excitation system and, as such, require that their output terminals be energized with AC voltage and supplied with reactive power to develop the magnetic flux. Induction generators are therefore normally not capable of supplying sustained fault current into faults on the SRP system. Such units are generally not capable of supplying isolated load when separated from the SRP system; however, it is possible for an induction generator to become self-excited if a sufficient amount of capacitance exists at its output terminals. Under conditions of self-excitation, an induction generator will be capable of supplying isolated load, providing the load is within the units' output capability. In most cases when self-excitation occurs it will be accompanied by a sudden increase in terminal voltage. SRP and its other customers must be protected from out-of-sync closing and over-voltages that can occur whenever an induction generator becomes self-excited.

6.3 Static Inverters

Static inverters convert DC power to AC by means of electronic switching. Switching can be controlled by the AC voltage of the SRP supply system (line-commutated) or by internal electronic circuitry (forced-commutated). Line-commutated inverters are generally not capable of operating independently of the SRP AC supply system and, as such, cannot normally supply fault current or isolated loads. Forced-commutated, or self-commutated, inverters are capable of supplying fault current and load independently of the AC supply system. Any inverter that is to be interconnected with SRP must be specifically designed for that purpose, that is, it must be designed to accommodate parallel interfacing and operation.

6.4 Definition of Generator Size Classes

The following generator size classifications are used in determining specific minimum protective requirements for DG facilities. Specified ratings are for each connection to the SRP system.

- (a) Class I -- 50 kW or less, single or three phase
- (b) Class II -- 51 kW to 300 kW, three phase
- (c) Class III -- 301 kW to 5,000 kW, three phase
- (d) Class IV -- over 5,000 kW, three phase

7. INTERCONNECTION TECHNICAL REQUIREMENTS

The requirements and specifications outlined in this section are applicable to DG interconnected for Parallel Operation with the SRP distribution system. The protection and safety devices and other requirements specified in the following sections are intended to provide protection for the SRP system, SRP workers, other SRP customers and the general public. They are not imposed to provide protection for the Customer's generation equipment or personnel; that is the sole responsibility of the Customer.

With respect to the above protection objectives, it is necessary to disconnect the parallel generator when trouble occurs. This is to ensure that if a fault on the SRP system persists, the fault current supplied by the Customer's generator is interrupted, and to prevent Islanding.

The Customer is solely responsible for the protection of his equipment from Reclosing by SRP. SRP normally applies instantaneous (0.1 seconds) Reclosing to overhead distribution circuits. The Customer must ensure that when the SRP source breaker trips, the DG is disconnected from the SRP circuit prior to automatic reclosure by SRP. Reclosing out of synchronism with the Customer's generator, may cause severe damage to Customer equipment and could also pose a serious hazard to Customer or SRP personnel.

7.1 General Technical Requirements

- 7.1.1 The Customer is responsible for obtaining and maintaining all required permits and inspections indicating that the Customer's generating facility complies with all applicable codes, ordinances and statutes relating to safety and construction.
- 7.1.2 The connection of multiple generators to the same SRP service are permitted; however, a single disconnect switch for the facility will generally be required (normally located at the service entrance section).
- 7.1.3 In the event that a generator, or aggregate of generators, are of sufficient size to carry the minimum load of the SRP distribution feeder, or if a generator size and physical location on a feeder is such that it could support an isolated (islanded) section of the feeder, then a transfer trip scheme is required at the Customer's expense. A transfer trip scheme includes a communication channel and telemetering. In certain instances, a dedicated SRP feeder may be required.
- 7.1.4 To prevent the opening and subsequent closing of equipment into an un-synchronized generator, the Customer shall ensure that any potential open points such as breakers or fused disconnect switches, located between the generator breaker and SRP service, are appropriately equipped. This is accomplished with either keyed or other suitable mechanical interlocks to prevent the open points from being inadvertently closed when the generator breaker is closed, or by using contacts that will instantaneously trip the generator breaker if any such switch or breaker is opened while the generator breaker is closed.
- 7.1.5 The Customer shall ensure that the design and installation of electric meter(s) meet SRP's requirements in the SRP Electric Service Specifications.

- 7.1.6 To avoid delays or unnecessary expenses, it is strongly recommended that the Customer submit specifications and detailed plans, as specified in the Application and Equipment Information Form (refer to Appendix B), for the installation to SRP for review and written approval prior to ordering any equipment. Written approval by SRP does not indicate acceptance by other authorities.

7.2 Disconnect Switch

The Customer shall install and maintain a manually-operated load-break disconnect switch capable of being locked in a visibly open position by a standard SRP padlock. This switch shall completely open and isolate all ungrounded conductors of the DG from the SRP system. For multi-phase systems, the switch shall be gang-operated.

The disconnect switch blades, jaws and the air-gap between them shall be clearly visible when the switch is in the open position. The disconnect switch shall be installed in a place to provide easy and unrestricted accessibility to SRP personnel on a 24-hour basis. SRP shall have the right to lock open the disconnect switch without notice to the Customer, when interconnected operation of the Customer's generating facility with the SRP system could adversely affect the SRP system or endanger life or property, or upon termination of the Interconnection Agreement. In the event that SRP locks open the disconnect switch, the Customer shall not remove or tamper with the lock.

The disconnect switch will normally be required to be installed at the Customer's electrical service entrance section.

The disconnect switch must be rated for the voltage and current requirements of the generation facility, and must meet all applicable UL, ANSI and IEEE standards. The switch shall meet the requirements of the National Electrical Code, and the switch enclosure shall be properly grounded.

In situations where the DG is in a remote location, or there are several DGs on a given SRP feeder, SRP may require that a special remote-controlled switch be installed, or that SRP be compensated for a troubleshooter's time to travel to and from the site and open the disconnect switch during Hold Tag or clearance conditions.

7.3 Power Quality/Performance Criteria

The Customer shall ensure that the electrical characteristics of its load and generating equipment will maintain SRP's normal power quality requirements. Any deviation from sine waveform or unusual short interval fluctuations in power demand or production shall not be such as to result in impairment of service to other customers. Power factor and quality issues are defined in SRP's Electric Service Specifications and the SRP Rules and Regulations documents.

7.4 Voltage Requirements

The DG generated voltage shall follow, and not attempt to oppose or regulate changes in the voltage at the Point of Interconnection, unless otherwise agreed to by SRP and the Customer.

7.5 Labeling Requirements

The Customer shall conform to the NEC for labeling of generation equipment, switches, breakers, etc. SRP will assume the responsibility for labeling any SRP equipment. The disconnect switch will be labeled by SRP with a red placard (and the standard shock hazard sticker) as shown below:

DISTRIBUTED GENERATION DISCONNECT SWITCH

WARNING – ELECTRIC SHOCK HAZARD –
DO NOT TOUCH TERMINALS --
TERMINALS ON BOTH THE LINE AND LOAD SIDES MAY BE
ENERGIZED IN THE OPEN POSITION

7.6 Protective Requirements

7.6.1 General Requirements

- 7.6.1.1 The Customer shall be solely responsible for properly protecting and synchronizing the DG with the SRP system.
- 7.6.1.2 Customer facility shall include an automatic interrupting device that is listed with Underwriter's Laboratories, and is rated to interrupt available fault (short circuit) current. The interrupting device shall be tripped, as a minimum, by all protective devices required herein.
- 7.6.1.3 For generator classes II and above (>50 kW), utilizing discrete relays, separate and independent voltage and frequency relays and associated trip paths to the generator breaker (automatic interrupting device) are required. This is to ensure a redundant trip function in the event of a single relay failure or out-of-tolerance condition. It is acceptable however, for the over/under voltage functions to be integrated into a single over/under voltage relay, and for the over/under frequency functions to be integral to a single over/under frequency relay. These are sometimes referred to as Integrated Distributed Resources, or IDR's. Protective relays or microprocessor-based devices may be used provided that the required functionality and redundancy described herein is demonstrated. For generator protective schemes that utilize microprocessor based, multi-function relays, the protective relay failure condition will generate an alarm and will also trip the generator breaker or contactor. The Customer is responsible for maintaining safe grounding. The Customer shall ensure that the DG protective relaying and controls are adequately protected from electrical surges.

7.6.2 Generator Class Protective Requirements

7.6.2.1 Class I (Single or Three Phase: 50 kW or less) Requirements

An under-voltage contactor is required. A synchronizing scheme is also required for synchronous generators and inverters that are capable of being forced-

commutated.

7.6.2.2 Class II (Three Phase: 51-300 kW) Requirements

1. Protection for overvoltage, undervoltage, overfrequency, and underfrequency and a synchronizing scheme.
2. For installations interconnected to SRP through a transformer with connections that will not supply current to a ground fault on the SRP system, a special ground fault detection scheme may be necessary. SRP will advise Customer of any such requirements after a preliminary review of the Customer's proposed installation.
3. Other equipment such as supervisory control and alarms, transfer-tripping schemes, telemetering and associated communications channels may be necessary. This is especially the case when the generator, or an aggregate of generators is large relative to the minimum load on a feeder or sectionalized portion of the feeder; the DG is involved in power transactions requiring the grid; or the DG is remotely controlled by, or dispatched by SRP. SRP will advise the Customer of any communications requirements after a preliminary review by SRP Engineering and Operations departments of the proposed installation.

7.6.2.3 Class III (Three Phase: 301-5,000 kW)

1. Utility Grade protection devices and equipment.
2. Protection for overvoltage, undervoltage, overfrequency, and underfrequency and a synchronizing scheme.
3. For installations interconnected to SRP through a transformer with connections that will not supply current to a ground fault on the SRP system, a special ground fault detection scheme may be necessary. SRP will advise Customer of any such requirements after a preliminary review of the Customer's proposed installation.
4. Other equipment such as supervisory control and alarms, transfer-tripping schemes, telemetering and associated communications channels may be necessary. This is especially the case when the generator, or an aggregate of generators is large relative to the minimum load on a feeder or sectionalized portion of the feeder; the DG is involved in power transactions requiring the grid; or the DG is remotely controlled by, or dispatched by SRP. SRP will advise Customer of any communications requirements after a preliminary review by SRP Engineering and Operations departments of the proposed installation.

7.6.2.4 Class IV (Three Phase: Greater than 5,000 kW)

Units of this size will be reviewed on a case-by-case basis.

The minimum protective relaying requirements for Parallel Operation of DG are summarized in the following table:

Summary of Minimum Protective Relaying Requirements

	Summary of Requirements
Class I 50 kW or less	Undervoltage contactor Synchronizing*
Class II 51 to 300 kW	Overvoltage, Undervoltage Overfrequency, Underfrequency Synchronizing* Transfer trip (possibly)
Class III 301 to 5,000 kW	Utility Grade Overvoltage, Undervoltage Utility Grade Overfrequency, Underfrequency Utility Grade Synchronizing* Transfer trip (possibly)
Class IV Greater than 5,000 kW	Requirements are on a case-by-case basis

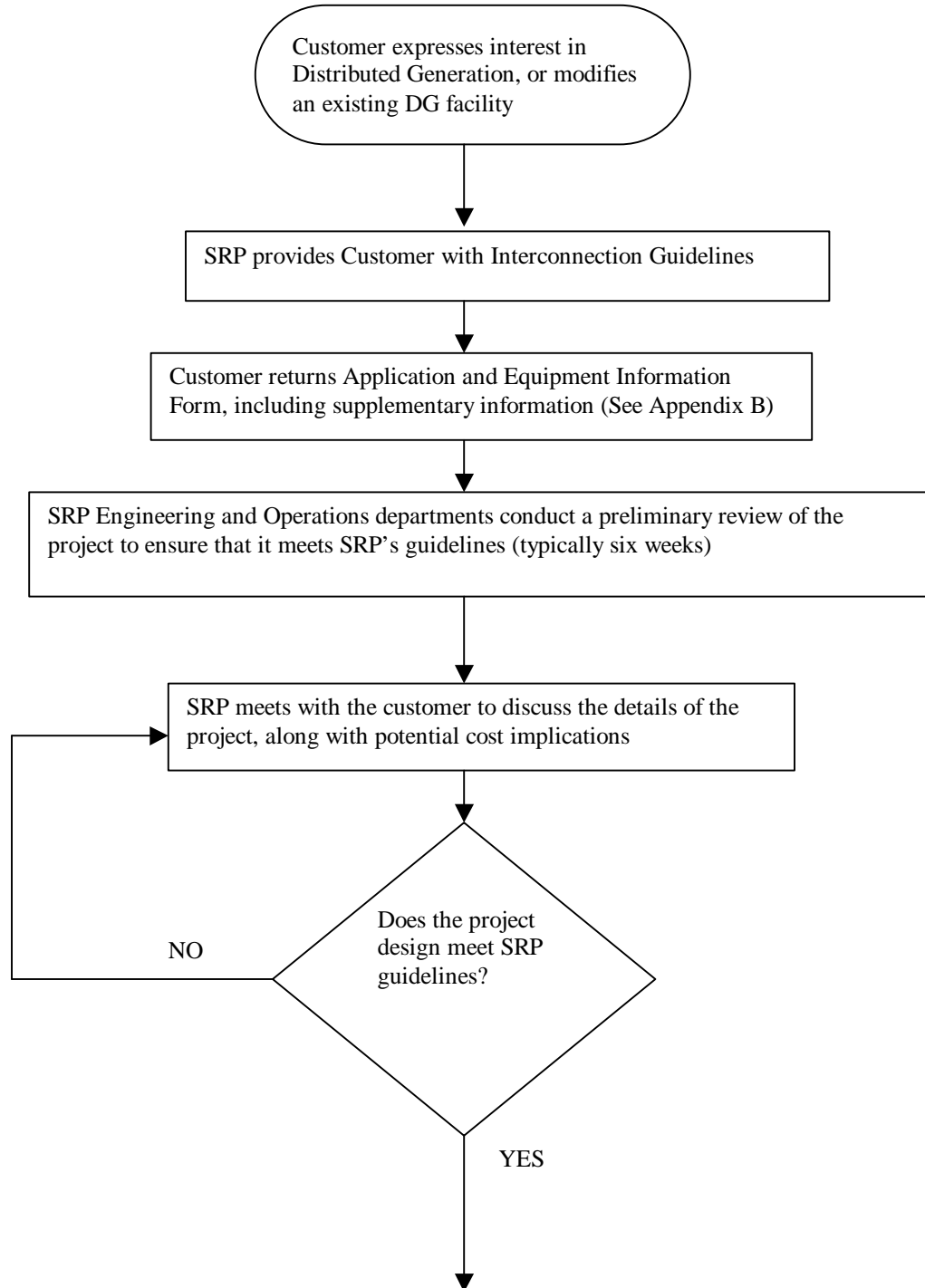
*Synchronizing is required for synchronous generators and inverters only

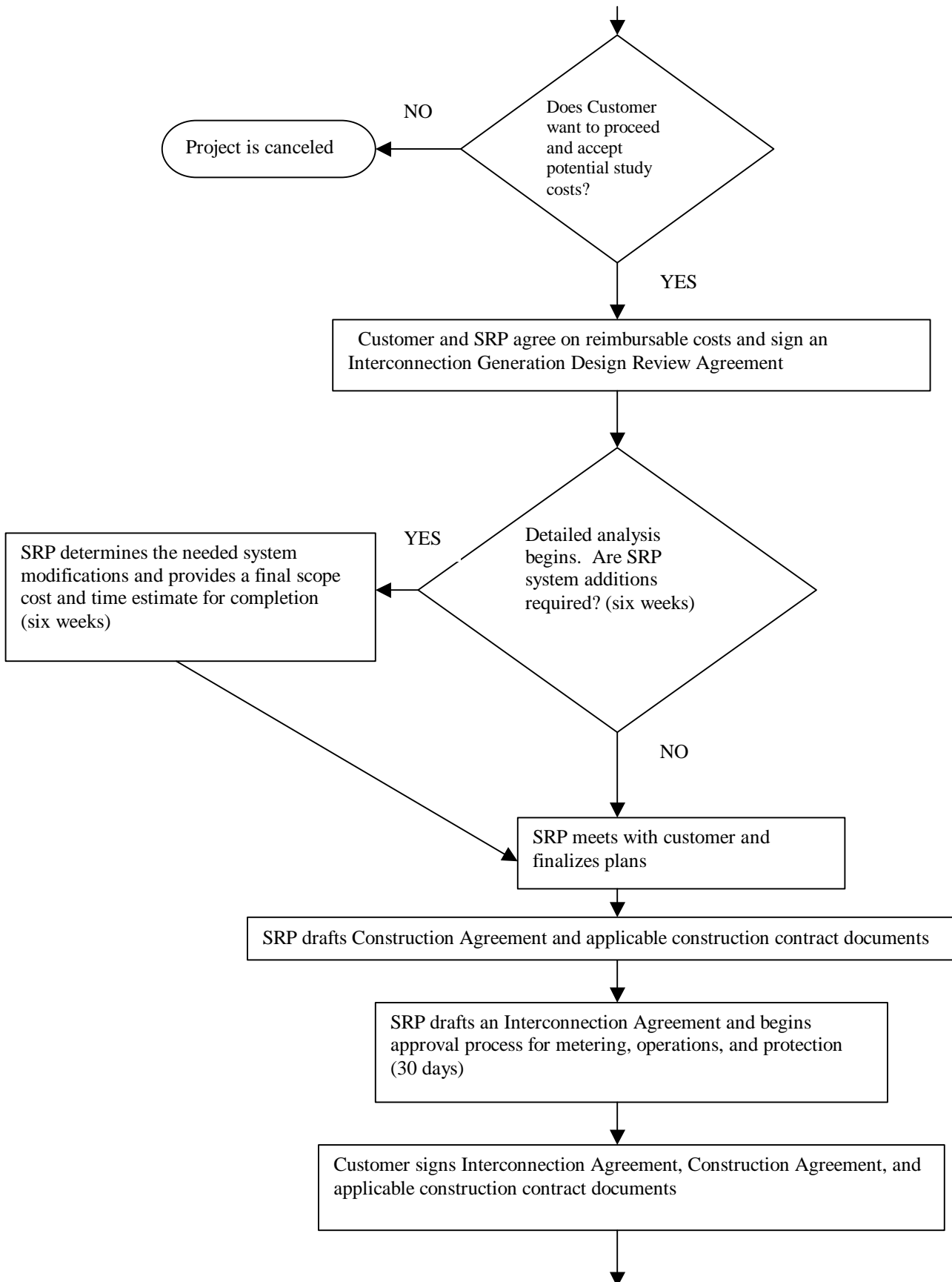
7.6.3 Relay Settings

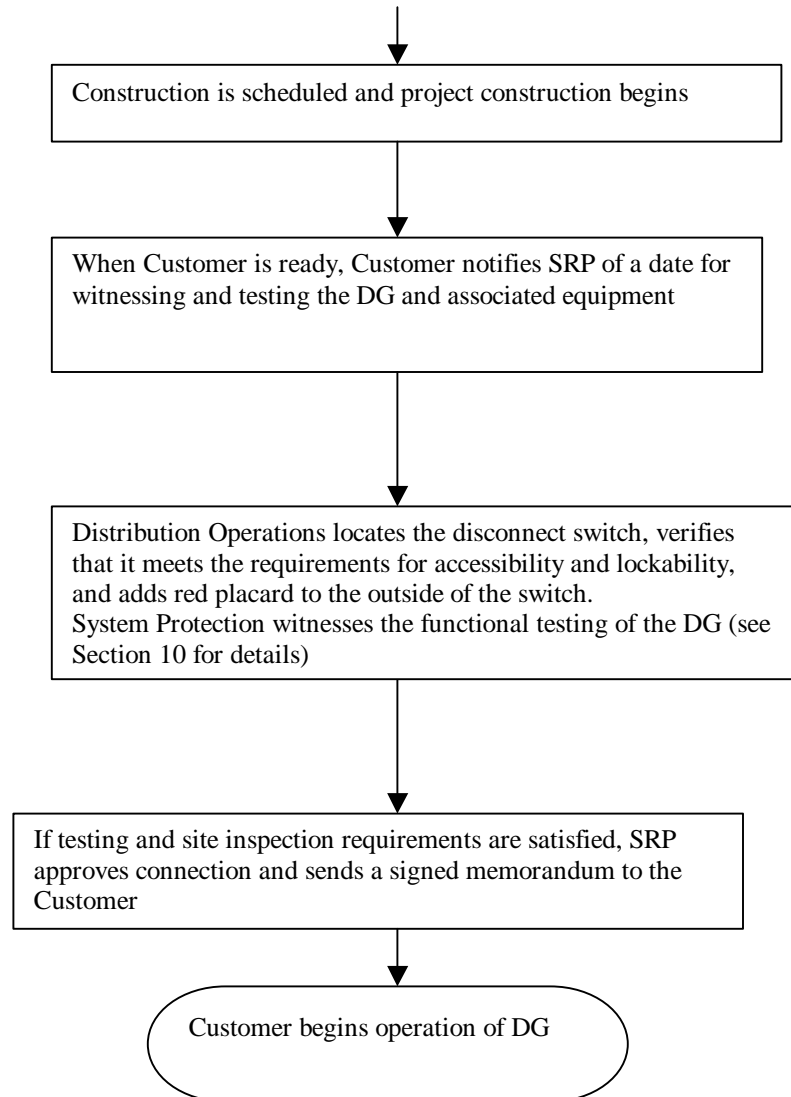
Voltage and frequency relays needed for minimum interface protection for all classes will have setting ranges as specified by SRP. The Customer should discuss these ranges with SRP prior to designing or installing a DG. For class III and IV units, there may be additional frequency setting requirements to accommodate grid load shedding in accordance with practices of the Western System Coordinating Council.

8. TYPICAL PROCESS FOR INSTALLING A DG

The process is summarized in flowchart form below, (including the typical number of days to complete).







- 8.1** The protective and safety devices (relays, circuit breakers, disconnect switches, etc.) specified in this document must be installed and placed into service before allowing Parallel Operation of Customer's generation facilities with the SRP system. The purpose of these devices is to isolate the Customer's generating equipment from the SRP system whenever faults or disturbances occur, and for maintenance purposes. Modifications to the SRP electrical system configuration or protective equipment may also be required, generally at the expense of the Customer, in order to accommodate parallel generation. Additional agreements may be required between the Customer and SRP before modifications to the distribution system are made.

SRP approvals given pursuant to the review and approval process and the Interconnection Agreement shall not be construed as any warranty or representation to Customer or any third party regarding the safety, durability, reliability, performance or fitness of Customer's generation and service facilities, its control or protective device or the design, construction, installation or operation thereof.

SRP strongly encourages each Customer to contact and work closely with SRP at the conceptual stages of the design to ensure that the project proceeds smoothly. SRP requires a single point of contact with which to coordinate the interconnection process and a single SRP point of contact will be provided to the Customer.

- 8.2** In the event it is necessary for SRP to install interconnection facilities on its system (including but not limited to control or protective devices, or any other facilities), in order to accommodate or protect the Customer's generation facility or SRP equipment, SRP will inform the Customer of the cost and the Customer is responsible to reimburse SRP for the costs incurred by SRP.
- 8.3** Following SRP's approval of the DG, if the Customer desires to make changes or modifications to the DG, including, but not limited to, equipment, operational plans or protective devices, the Customer must submit the changes to SRP. This will require that the Customer resubmit the application form in Appendix B, and go through the process described in the flowchart portion of this Section. No change or modification may be made without the prior written approval of SRP.

9. TESTING REQUIREMENTS

9.1 Relay Testing Prior to the Witness/Commissioning Tests:

The Customer shall have all associated protective devices field-tested and calibrated by qualified personnel. Calibration shall include on-site testing of trip set points and timing characteristics of the protective functions. Written copies of the results shall be sent to SRP at least five days prior to the witness testing described below. If there are differences in the original design settings and the field settings, SRP requires additional time to review those differences prior to witness testing.

9.2 Witness/Commissioning Test Requirements:

On the day of witness testing, the Customer shall demonstrate, in the presence of SRP personnel that:

- (a) Relay settings are consistent with the written calibration tests previously provided by the Customer.
- (b) Operation of each protective output contact results in the desired operation of the appropriate protective device (usually a breaker or contactor). For static inverters rated less than 50 kW, a trip-timing test with simulated loss of voltage will be sufficient.
- (c) The DG is capable of synchronizing with the SRP grid.
- (d) The DG properly disconnects from the SRP system under simulated disturbance conditions.
- (e) SRP remote visibility or control of any devices associated with the DG function properly, if applicable.
- (f) Settings of programmable logic devices are correct, if applicable.

10. OPERATIONAL AND MAINTENANCE REQUIREMENTS

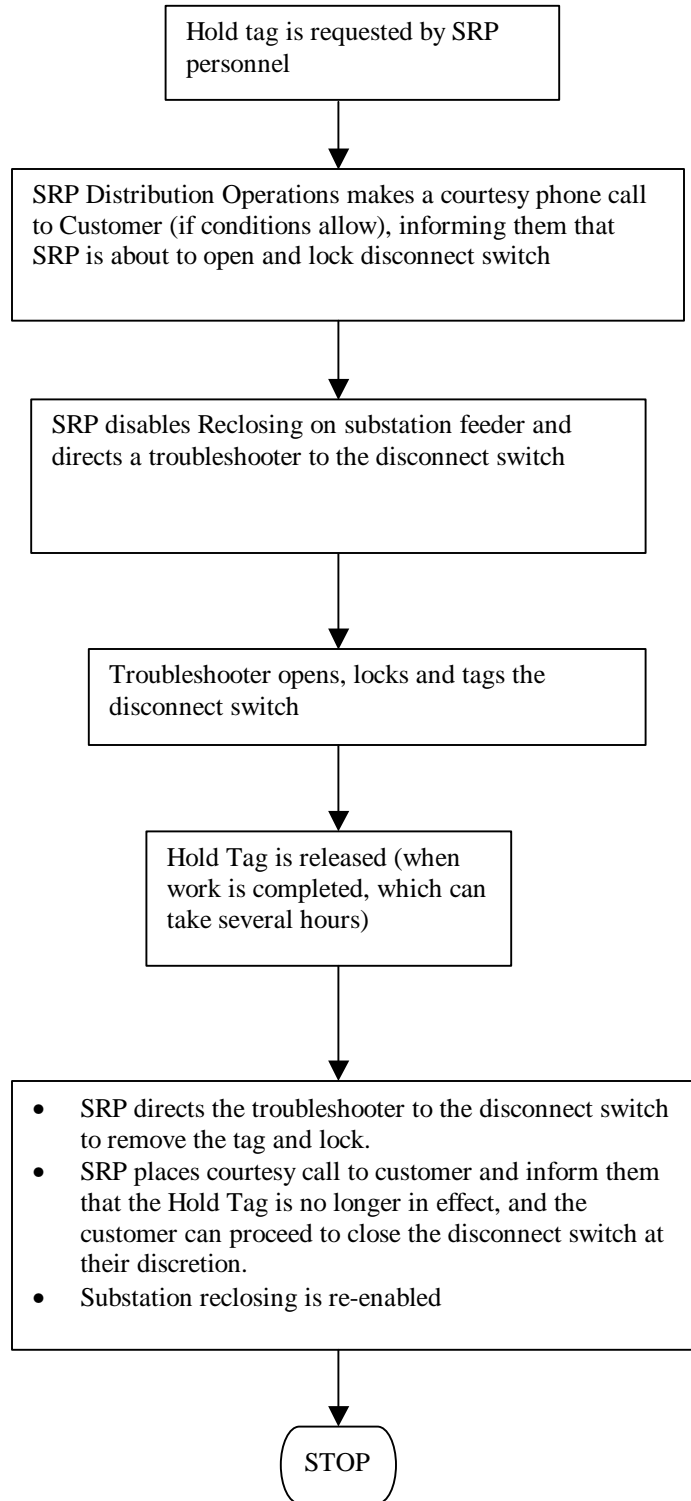
- 10.1** The Customer shall be responsible for operating and maintaining the DG in accordance with the requirements of all applicable safety and electrical codes, laws and governmental agencies having jurisdiction.
- 10.2** SRP may request witnessing of functional trip tests on an annual basis. When requested, the Customer shall notify SRP when such tests are to be performed at least five working days prior to such tests, and shall allow SRP personnel to witness the testing. In addition, SRP may annually request that all protective devices be field tested and calibrated by qualified personnel, and that written copies of the results be provided to SRP.
- 10.3** SRP, including its employees, agents and representatives, shall have the right to enter the Customer's premises to:
- (a) Inspect the Customer's generating facility, protective devices, and to read or test instrumentation equipment that SRP may install, provided that reasonable advance notice is given to the Customer prior to entering its premises.
 - (b) Maintain or repair SRP equipment.
 - (c) Disconnect the generating facility without notice if, in SRP's opinion, a hazardous condition exists and such immediate action is necessary to protect persons, SRP facilities or other customers' or third parties' property and facilities from damage or interference caused by the Customer's generating facility, or improperly operating protective devices.
 - (d) Open the Disconnect Switch without notice if SRP personnel require an operating clearance or Hold Tag.

10.4 SRP Hold Tags

Hold Tags are used to protect equipment as well as personnel who are working on or near energized equipment, whereby Reclosing of a line is disabled. When a Hold Tag for a circuit is in effect, if the circuit trips open, it will not be re-closed until it is verified that all personnel are in the clear. As it relates to DGs, circuits with hold tags shall have all potential sources of back-feed removed by opening, locking and tagging the appropriate disconnect switch. The number of hold tags at any given time varies from a handful on weekends and holidays, to more than 50 on weekdays (SRP has approximately 1,000 12 kV feeders). Only in extreme conditions are Hold Tags kept overnight; typically they are taken in the morning and released in the afternoon. Although Hold Tags are only issued to SRP personnel, they can be taken as a result of conditions outside of SRP's control, at the request of City personnel, the fire department, or other utilities.

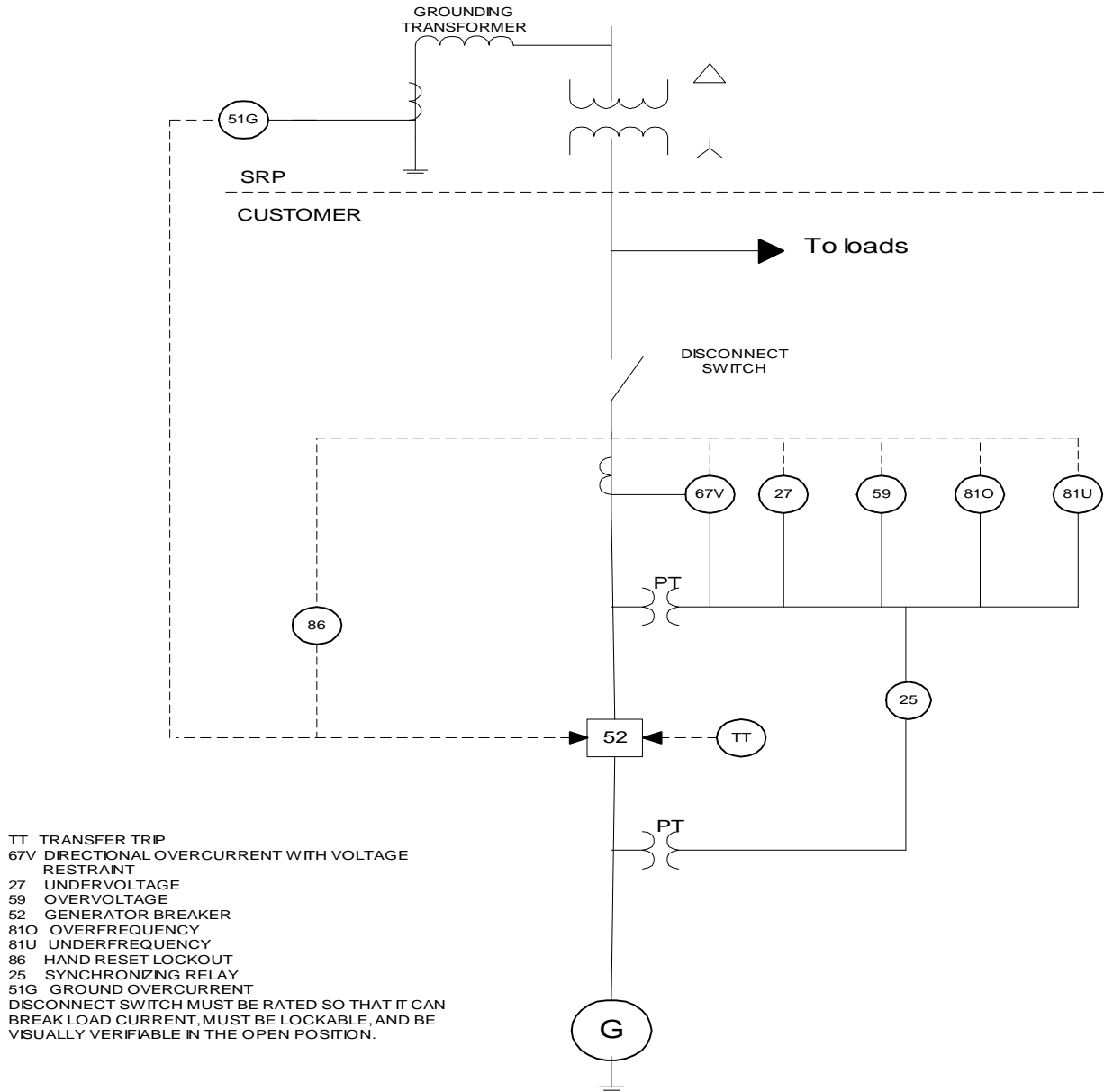
Following the release of an SRP clearance or Hold Tag, where it was necessary for SRP to open the Disconnect Switch, SRP personnel will not normally close the switch. It will normally be the Customer's responsibility to close the switch after ensuring that all generation sources that could potentially be energizing the Customer's side of the switch are off, so as to eliminate any possibility of closing the SRP grid onto an out-of-sync generator.

The Hold Tag procedure is included below in flowchart form:

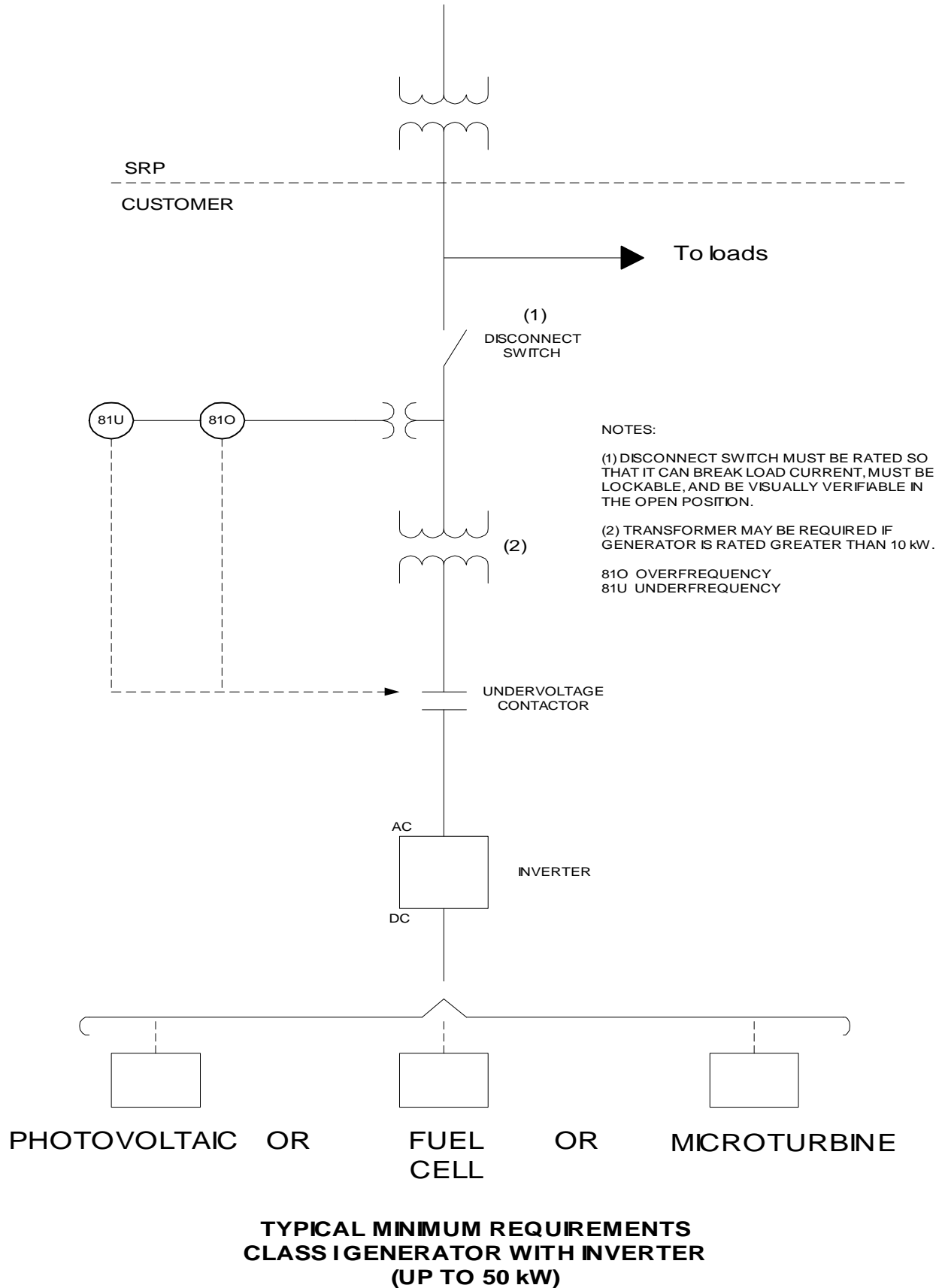


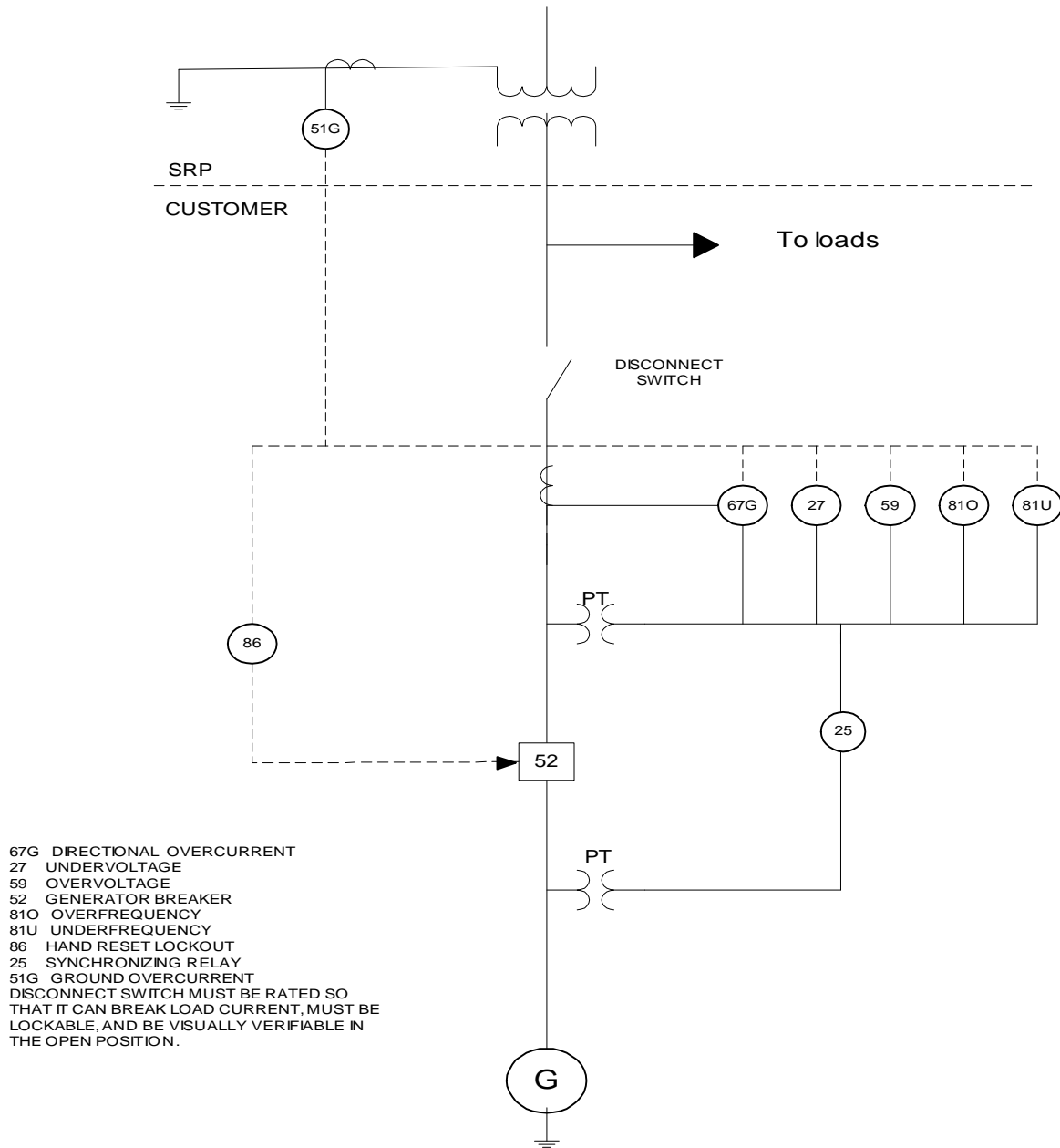
APPENDIX A

SAMPLE SYSTEM ONE LINE DIAGRAMS



**TYPICAL MINIMUM REQUIREMENTS
CLASS III SYNCHRONOUS GENERATOR
(301- 5,000 kW; WITH TRANSFER TRIPPING AND
GROUNDING TRANSFORMER)**





**TYPICAL MINIMUM REQUIREMENTS
CLASS II SYNCHRONOUS GENERATOR
(51-300 kW, NO TRANSFER TRIPPING REQUIRED)**

APPENDIX B
DISTRIBUTED GENERATOR
APPLICATION AND EQUIPMENT INFORMATION FORM

SITE AND CUSTOMER INFORMATION

(Complete all items)

Customer Name _____ Telephone _____

Company Name (if applicable) _____

Mailing Address _____

Generating Facility Address _____

Project Contact _____ Telephone _____

SRP Account Number _____ Electric Meter Number _____

Completed By _____ Telephone _____

PROPOSED OPERATION

(Answer all questions. Please contact SRP for help in filling out this form.)

- A. Does the DG plan on selling or exporting any excess power generated back to SRP? (Yes or No) _____. If “Yes”, explain the proposed operation and estimated power to be exported, and also provide name of proposed purchaser of this power.

- B. Describe the intended times of operation and times of year that the DG is to be in parallel with the SRP grid.

GENERATOR INFORMATION

- A. Manufacturer _____
- B. Type (Synchronous, Induction, D.C.) _____
- C. Energy source (Natural Gas, Solar, etc.) _____
- D. Nameplate rating
 Voltage _____ kVA _____
 Power Factor _____ Frequency _____
 Model No. _____ Single or Three Phase _____
- E. Generator Electrical Characteristics (on the machine base, for Class II and above)
 Synchronous Reactance ($X'd$) _____
 Transient Reactance ($X'd$) _____
 Subtransient Reactance ($X''d$) _____
 Zero sequence Reactance (X_0) _____
 Negative Sequence Reactance (X_2) _____

STATIC INVERTER

Inverter for DC generator:

Manufacturer _____
 Manufacturer's Model Number _____
 Line or Self (Forced) Commutated Inverter _____
 Battery backup? _____

PROTECTION EQUIPMENT

Complete all applicable items (attach separate sheets as necessary)

- A. Manufacturer's name for each protective device
- B. Manufacturer's model number for each protective device
- C. Range of available settings for each protective device
- D. Proposed settings (trip setpoint and time) for each protective device
- E. Ratios of associated current transformer. If multi-ratio, state the available ratios and which ratio will be used
- F. Describe operation for tripping of the interface or generator circuit breaker for both
1. SRP outage
 2. SRP short circuit (three phase and single phase to ground)

SUPPLEMENTARY INFORMATION

The information below is to be submitted for all projects. Provide three sets of all diagrams, including any revisions or changes as they are made. Diagrams must also include project name and address, show generator size and all protective relaying and control equipment, as well as electric service entrance and SRP meter.

- A. Electrical One-Line Diagram
- B. Electrical Three-Line Diagram:
Include all neutral and ground conductors and connections.
- C. Control Schematics and Connection Diagrams:
Diagrams must show the detailed wiring of all protective relays and control functions, and include control power source and wiring.
- D. Site Plan and Maps:
Include the arrangement of the major equipment, including the electric service entrance section and SRP meter, location of generator and interface equipment, and location of the disconnect switch. Include the street address and location of the any lock-boxes, etc.
- E. Testing Company:
Provide the name of the company that will do the protective relay bench testing and the trip circuit functional tests and the anticipated start up date.
- F. Point of Contact:
If the interconnection and start-up process is to be coordinated through a party or individual other than the Customer, provide the name, company, address and phone number of that individual or party with whom SRP is to coordinate the interconnection.